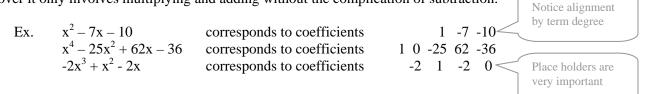
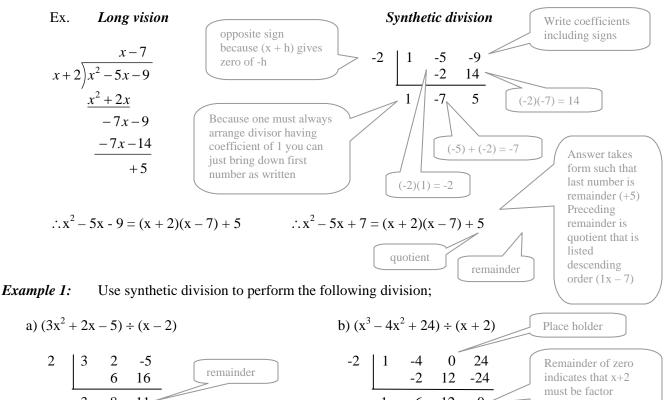
3.5B – Synthetic Division

Synthetic division is a short form technique used to divide polynomials. A grid is used to align variables so that one can just focus on the coefficients and thus simplify the work involved. Moreover it only involves multiplying and adding without the complication of subtraction.



The technique is outlined side by side with long division using $(x^2 - 5x - 9) \div (x + 2)$



$$3 \quad 8 \quad 11^{-1} \quad 1 \quad -6 \quad 12 \quad 0$$

$$\therefore (3x^{2} + 2x - 5) = (x - 2)(3x + 8) + 11 \qquad \qquad \therefore (x^{3} - 4x^{2} + 24) = (x + 2)(x^{2} - 6x + 12)$$

$$c) (2x^{3} + 4x^{2} - 3x - 60) \div (x - 3) \qquad \qquad d) (6x^{3} + 31x^{2} + 25x - 12) \div (2x + 3)$$

$$3 \quad \underbrace{ \begin{vmatrix} 2 & 4 & -3 & -60 \\ 6 & 30 & 81 \\ 2 & 10 & 27 & 21 \end{vmatrix}} \qquad \underbrace{ \begin{matrix} \text{Using -1.5} \\ \text{might be} \\ \text{easier} \end{matrix} \qquad \underbrace{ \begin{vmatrix} 6 & 31 & +25 & -12 \\ -9 & -33 & +12 \\ 6 & 22 & -8 & 0 \end{vmatrix}} \qquad \underbrace{ \begin{matrix} \text{Need to have} \\ \text{coefficient of} \\ 1, \text{ so write as} \\ (x + 3/2). \end{aligned}}$$

 $\therefore (2x^3 + 4x^2 - 3x - 60) = (x - 3)(2x^2 + 10x + 27) + 21 \qquad \therefore (6x^3 + 31x^2 + 25x - 12) = (x + 1.5)(6x^2 + 22x - 8)$

Synthetic division can become complicated with fraction or when dividing by anything higher then a linear term. Hence one might revert back to long division to avoid mistakes.

have

3.5B – Synthetic Division Practice Questions

1. Use synthetic division to divide. Express answer in form f(x) = d(x) q(x) + r(x)

a) $(x^2 - 3x + 5) \div (x - 2)$ b) $(3x^2 + 2x - 5) \div (x - 2)$ c) $(3x^2 - 4) \div (x - 4)$ e) $(x^3 + 3x^2 - 16x + 12) \div (x - 2)$ g) $(9x^3 - 3x^2 - 4x + 2) \div (x - 2/3)$ i) $(x^3 - 9x^2 + 26x - 24) \div (x - 2)$ k) $(x^4 + 63x - 5) \div (x + 4)$ m) $(x^4 + 3x^2 + 4) \div (x^2 + 2x - 1)$ b) $(3x^2 + 2x - 5) \div (x - 2)$ d) $(m^3 - m^2 + 4m + 15) \div (m^2 + 2m - 3)$ f) $(6a^3 + 4a^2 + 9a + 6) \div (3a + 2)$ h) $(4x^3 + 32) \div (x + 2)$ j) $(-x^3 + 3x + 2) \div (x - 2)$ h) $(3x^3 - 72x - 5) \div (x - 5)$ m) $(6x^5 - 7x + 4) \div (x + 1)$

- 2. Find the value of k such that when $2x^3 3x^2 + kx 1$ is divided by x 1 the remainder is 2.
- 3. When a given polynomial is divided by x 2, its quotient is $x^2 3x 7$ and its remainder is -24. What is the original dividend polynomial?
- 4. Find the quotient only; a) $\frac{y^3 28y 41}{y + 4}$ b) $\frac{4x^3 10x^2 + 6x 15}{2x 5}$
- Answers 1. a) (x-2)(x-1) + 3 b) (x-2)(3x+8) + 11 c) (x-4)(3x+12) + 44 d) $(m^2+2m-3)(m-3) + (13m+6)$ e) $(x-2)(x^2+5x-6)$ or (x-2)(x+6)(x+1) f) $(3a+2)(2a^2+3)$ or $(a+2/3)(6a^2+9)$ g) $(x-2/3)(9x^2+3x-2) + 2/3$ h) $(x+2)(4x^2-8x+16)$ i) (x-2)(x-3)(x-4) j) (x-2)(-1)(x+1)(x+1) or $-(x-2)(x+1)^2$ k) $(x+4)(x^3-4x^2-16x-1)-1$ l) $(x-5)(3x^2+15x+3)+10$ m) $(x^2+2x-1)(x^2-2x+8)-(18x+12)$ n) $(x+1)(6x^4-6x^3+6x^2-6x-1)+5$ 2. 4 3. x^3-5x^2-x-10 4. a) $y^2-4y-12$ b) $2x^2+3$ or $4x^2+6$

Which of these questions are best down with synthetic division. Which questions are best done using long division to avoid mistakes?